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CHEMICAL AND BIOLOGICAL WARFARE: A MANAGEABLE PROBLEM

by

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A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

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27 January 2003

Preface

This paper focuses on military activities in an area threatened or contaminated by chemical and biological (CB) weapons. Specifically, to what extent are United States military operations affected in a chemical and biological warfare (CBW) environment? CB weapon use against civilians will be examined only indirectly. The ramifications of CB targeting against non-combatants, while certainly significant, are outside the scope of this paper.

Introduction

> The chlorine gas originally used was undeniably cruel, but no worse than the frequent effect of shell or bayonet, and when it was succeeded by improved forms of gas both experience and statistics proved it least inhuman of modern weapons. But it was novel and therefore labeled an atrocity by the world which condones abuses but detests innovations.
>
> B. H. Liddell Hart, *A History of the Real War*, 1935

The Gulf War of 1991, recent worldwide terrorist events, and the prospect of "Gulf War II" in 2003 have all heightened our concerns about CB weapons and their effects on military operations. In 1991, Saddam Hussein had just completed eight years of fighting in the Iran-Iraq War (1980-1988). Both sides extensively used chemical weapons against armed forces and civilian populations. Saddam was known to be ruthless and thought to be "irrational" as well. Many feared he would counter Coalition technical superiority with CB weaponry. Before Desert Storm commenced, U.S. military casualty estimates ranged from 10,000 to 20,000.[1] If Saddam had used the CB option, some felt the number of dead and wounded would be even higher.

Terrorism has also increased CBW chatter. It is clear that the terrorist penchant for mass casualties has driven them to use unconventional methods to further their aims. Aum

Shinrikyo used nerve agents against Tokyo subway riders. Timothy McVeigh blew up the Murrah Building with a fertilizer-bomb rental truck. Al-Qaeda plowed airliners into the World Trade Center and the Pentagon. Many believe future terrorist attacks will feature CB weapons used as a "poor man's atomic bomb." Even though terrorists usually avoid direct confrontation with armed forces, discussions of CB use against civilians serve as a debate catalyst for military operations in a CB contaminated area.

As for Gulf War 2003, many feel Saddam Hussein is more likely to use his CB arsenal now than he was in 1991. In the first Gulf War, the clearly-stated Coalition goal was to liberate Kuwait, not overthrow the Iraqi government. Even though Iraq lost the war, Saddam retained power. Now that the Bush Administration has articulated its desire for "regime change," Saddam may feel he is on Sun Tzuian "death ground."[2] With nothing left to lose, there is concern that the Iraqi dictator will unleash his CB agents as his last desperate act.

The anxiety about CBW is well-founded in that CB agents can surely maim and kill. But is this apprehension based on a logical understanding of the actual risks posed by CB weapons or is it more emotional because of our exposure to worst-case scenarios that have not been subjected to rigorous critique? U.S. military operations will be hampered by CB contamination but how severe will the degradation be? Are CB agents truly "weapons of mass destruction" or, as Liddell Hart writes in the opening quote, are they no more hazardous than any other threat encountered on the battlefield?

This paper is about CBW and CB weapons effects on U.S. military operations. Areas researched include: the foundation of CBW concern, practical problems (limitations) with CB weapon delivery, and hypothetical CBW combat scenarios (Desert Storm 1991

and Desert Storm 2003). The intent is to provide combat forces with a logical and realistic framework to accurately assess the CB threat enabling a proper balance of force protection and mission accomplishment.

The United States military is well-prepared to conduct operations in the CBW environment and CB weapons will have minimal impact on combat effectiveness. Contrary to what some would have us believe, effective dispersal of CB agents is not as simple as filling a crop-duster with sarin gas or anthrax spores and spraying troops in the open. Besides the negative political aspects, there are significant practical difficulties incorporating CBW into a useful military course of action. History shows that CB weapons have had the greatest impact on unprotected, poorly trained, and ill-disciplined ground forces. Even so, the CB contribution has been small (or even negligible) to the overall outcome of the conflict.

Foundation of CBW Concern: Emotion Versus Logic

> CB weapons are not the "poor man's atomic bomb," they don't even come close with the long-term devastation caused by even a small tactical nuke. Bad press is more responsible for that label than any historical incident.
>
> Albert J. Mauroni, *America's Struggle with Chemical-Biological Warfare*, 2000

As is often the case in our 24/7 cable news world, much of our "knowledge" about CBW comes from network pundits, journalist pontificators, and politicians concerned more with self-aggrandizement than actual constituent education. Take the notion of a news anchor reporting that a U.S. chemical weapons depot accident could kill 80,000[3] people or a government official raising a five-pound bag of sugar and stating that if it were anthrax it would wipe out Washington, D.C.[4] Both examples, while technically feasible, are no more relevant than saying Lake Erie could drown every person on the planet or that the hunting

ammunition at a local K-Mart could kill everyone in Terre Haute, Indiana. The chemical depot casualty number assumes the entire chemical stockpile is released and requires that every human within hundreds of miles be dolled out one drop of agent. The anthrax sugar bag would have to be perfectly dispersed in ideal conditions and the entire D.C. population would have to be standing outside inhaling for all their worth. While both worst-case scenarios are physically possible, neither is probable or even reasonably likely. As Amy Smithson writes "Theoretically, a quart of nerve agent contains roughly a million lethal doses, but in practice, over a *ton* of nerve agent would be needed to kill ten thousand people outdoors."[5] There are undoubted dangers associated with CB substances, but there are also risks associated with everyday household cleaning compounds, eating undercooked hamburger, and crossing a city street. With reasonable care and proper precautions, the threat posed by all of these potential hazards, including CB weapons, can be minimized.

Our concerns about CBW may be grounded more in the visceral than the cerebral. There are those who feel CB weapons are somehow outside the realm of "civilized" and "humane" combat. But Brad Roberts notes:

> A number of people from developing countries have expressed their view that to die by chemical weapons is neither more or less horrible than to die by bullet or flame and who wonder themselves how Westerners can ascribe selective humaneness to conventional weapons.[6]

Further, the American representative at the 1899 Hague Conference, noted naval theorist Captain A.T. Mahan, cast the lone dissenting vote against a prohibition on the use of chemical shells. Mahan declared:

> . . . it was illogical and not demonstrably humane to be tender about asphyxiating gas, when all were prepared to admit that it was allowable to blow the bottom out of an ironclad at midnight, throwing four or five thousand men into the sea, to be choked by water, with scarcely the remotest chance of escape.[7]

Whether or not CB weapons are less humane than conventional weapons is debatable but this paper assumes they will be used against our armed forces and asks what the impact will be? To comprehend the true nature of the CBW threat, it is useful to examine actual CB weapons effects on their intended targets. World War I, the Iran-Iraq War, and Aum Shinrikyo CB attacks provide some useful insight.

World War I. Although CBW is nearly as old as warfare itself,[8] World War I was the first widespread and systematic application of chemical weapons. For decades after the war was over, some of the most vivid combatant memories were about gas. Germany searched for a way to break the trench warfare deadlock and chemical ordnance seemed to be a viable option. They gassed the Russians in the east and the French, British, Canadians, and Americans in the west. The allies retaliated in kind. Thirty substances were used in combat including asphyxiates, toxics, respiratory irritants, poisons, and blister agents. Yet, despite their undoubted psychological effects, chemical weapons provided only modest tactical success and never facilitated a strategic breakthrough.[9]

The horrendous casualties created by chemical weapons early in WWI are understandable when one considers how vulnerable and unprepared the troops were. The intended targets, fielded forces, were massed in well-known stationary positions along the front lines and wore no protective equipment. Huge quantities of chemical cylinders were set up long before the intended attacks. When the wind became favorable, all one had to do was open valves and let the agents drift over the enemy positions. So the conditions were ideal for the chemical warfare (CW) attacker. After the war, General John J. Pershing lamented, "Whether or not gas will be used in future wars is a matter of conjecture, but the effect is so deadly to the unprepared that we can never afford to neglect the question."[10]

The American Expeditionary Forces never completely solved the CW problem, but casualties decreased as soldiers became better trained and equipped with protective masks. The CW effect was more psychological than physical, poison gas attacks "inspired fear that was all out of proportion to the damage done."[11] Gas produced 1.2 million non-fatal injuries and more than 91,000 fatalities in WWI.[12] These numbers are undeniably high, but when one considers that they account for less than six percent of the overall casualties and less than two percent of the overall fatalities, the relative significance becomes less dramatic.[13] The lesson from WWI is that CW can be effective against the unprepared, but even then it did not change the outcome of the war.

The Iran-Iraq War. Like Germany in WWI, Iraq used chemical weapons in its war with Iran as a way to diminish Iran's numerical superiority. The main difference between the two wars is that Iraq achieved its greatest CW successes with airborne ordnance. Table 1 shows relative Iraqi effectiveness with different methods of chemical attack.

Table 1. Iraqi Chemical Attacks in the Iran-Iraq War (1980-1988) [14]

Attack Type	Number of Attacks	Number Dead	Number Injured	Casualties Per Attack
Rocket	20	1	11	0.6
Artillery	74	27	1,031	14.3
Air	284	5,765	42,931	171.5
Totals	378	5,793	43,973	131.7

Clearly, aerial attack was the most preferred and successful type used by Iraq. Because the Iranians did not have an effective air defense system and never achieved air supremacy, the Iraqis were able to use flexible and accurate aircraft delivery systems throughout the war. Iran also persisted in using human-wave attacks which made them particularly vulnerable to aerial bombardment.

The CW lessons from the Iran-Iraq war are much the same as those from WWI; chemical weapons can be effective against those ill-equipped and poorly trained. Nevertheless, many military experts agree that chemical weapons did not have an appreciable impact on the outcome of the war.[15] Of the over one million war casualties, less than five percent were due to chemical agents. Lastly, it is important to note that against an air-dominant competitor like the United States, much of the Iraqi aerial advantage would be eliminated.

Aum Shinrikyo. On 20 March 1995, members from the religious cult Aum Shinrikyo released sarin and VX nerve gas into the Tokyo subway system. At the height of the morning rush hour, eleven agent-filled bags were punctured contaminating fifteen stations and three train lines. Twelve people died and nearly 700 required medical treatment for nerve agent exposure.[16] It is hard to imagine a more ideal target than thousands of unprotected commuters confined within train cars and underground stations. Nevertheless, even though the number of casualties was high, the number of fatalities was small compared to the prospective number of victims and near-perfect attack conditions. Much like the anthrax sugar bag example, the reality of this attack did not approach the potential that the eleven gas-filled bags represented.

While the Tokyo subway attack is well-know, many are unaware that between 1990 and 1993 Aum Shinrikyo also attempted to release botulinum toxin and anthrax against various targets in Japan. Despite eight separate attacks using a variety of delivery methods, the only reported casualties were “several pets.” Amy Smithson writes that “Aum Shinrikyo was brimming with highly educated scientists, yet the cult’s bio program was a

lemon."[17] Again, the dangers from CB weapons are real, but perhaps they are not as lethal as worst-case scenarios would make one believe.

The lessons from the three examples cited above are that CB weapons are most successful against "cooperative targets," those who are untrained, unprotected, concentrated, and immobile. Yet, even when CB agents are dispersed under optimum conditions, there are still some practical limitations (addressed in the next section) that will likely diminish their effectiveness.

Practical Problems Associated with CB Weapon Delivery

Have you ever ordered one of those amazing products shown on a television infomercial only to find out that it did not work quite as well as they advertised? Well, in some ways, the same is true for CB weapons. Many would have us believe that they are easy to manufacture (which in many cases they are) and that they are easy to properly disperse (which in many cases they are not). Having a stockpile of CB agents and having the ability to use them as effective weapons are two different things. The anthrax sugar bag, while potentially dangerous and useful as a prop, is unsuitable as a weapon. Even if an enemy has a credible CB delivery system, there are several environmental (wind, temperature, sunlight, soil permeability, and agent vapor pressure) and protection measures (immunization, masks, protective clothing, over-pressure systems, and antidote injectors) that can minimize CB weapons effects. An accurately-aimed bullet or conventional bomb has a high likelihood of achieving a desired effect but even an "on-target" CB weapon may prove no more than an inconvenience.

CB agents are dangerous to manufacture, store, and distribute and are difficult to incorporate into military strategy. Unlike conventional ordnance which can essentially be

used anytime, CB weapons require favorable conditions before application. Once released, chemicals and pathogens are unpredictable and can be just as dangerous to the attacker as to the intended targets (especially important when fighting forces are in close proximity). Political un-palatability usually means that CB ordnance requires a high level of centralized command and control which can become a critical vulnerability. These are just some of the general limitations and drawbacks presented by CB weapons. Specific practical CB issues and complications are examined below.

Chemical Weapons. Concerning chemical weapons, *Jane's NBC Defense Systems* reports, "contrary to popular belief, tons of agent are required if a general battlefield effect is sought and it needs to be delivered as accurately as [high explosive]." In WWI, it took a third of a ton of agent to cause a single casualty.[18] In the 1991 Gulf War there was significant consternation about Scud missiles armed with chemical warheads. The Al Hussein (Scud B) missile had a payload of 500 kilograms (1,100 pounds) and an accuracy of three kilometers (1.86 miles) circular error probable (CEP).[19] While the Scud payload was substantial, its poor accuracy and propensity to break up in flight would have made it only marginally useful as a CW delivery platform. Considering the dispersal of potential Coalition targets and the relatively small number of available launchers, it is doubtful that Scuds could have achieved meaningful effects against a properly protected military force.

Even those chemicals labeled as "persistent" remain a liquid hazard for as little as fifteen minutes and a vapor hazard for as little as eight hours in the most ideal agent conditions (least porous surface). The following table (next page) was compilied by Colonel Glenn F. Burgess, USMC (Retired), for an article in the *Marine Corps Gazette*:

Table 2. Chemical Weapon Hazard Duration Times [20]

Agent	Surface	Liquid Hazard	Vapor Hazard (Best Case)	Vapor Hazard (Worst Case)
Mustard Gas (Blister)	Concrete/Asphalt	10 Minutes	1 Hour	4.5 Hours
	Grass or Sand	10 Min - 4 Hrs	30 Minutes	4 Hours
	Painted Metal	15 Min - 6 Hrs	8 Hours	24 Hours
Sarin, Soman (Choking)	Concrete/Asphalt	10 Minutes	30 Minutes	6 Hours
	Grass or Sand	10 Min - 4 Hrs	30 Minutes	5 Hours
	Painted Metal	15 Min - 6 Hrs	8 Hours	24 Hours
VX (Nerve)	Concrete/Asphalt	10 Minutes	1 Hour	7.5 Hours
	Grass or Sand	10 Min - 4 Hrs	7.5 Hours	10 Hours
	Painted Metal	15 Min - 6 Hrs	8 Hours	24 Hours

The message is that if an attacker executes a chemical attack with high accuracy and sufficient agent quantity, it would present a localized "worst case" hazard for only 24 hours. Military operations could be hindered, but only temporarily.

Biological Weapons. It is attractive to use biological agents as weapons because the lethal doses are minute and they are far more difficult to detect in combat conditions. Nevertheless, like chemical weapons, Raymond A Zilinskas writes:

> . . . whenever biological weapons have been employed in battle, they have proven militarily ineffectual . . . [and] that although pathogens are all too willing to invade prospective hosts, human ingenuity so far has failed to devise reliable methods for effectively conveying a large number of pathogens to the population targeted for disease."[21]

With the exception of toxins, biological agents are living organisms which are difficult to store and deliver intact. They are vulnerable to explosive shock, heat, humidity, oxygen, and sunlight. Even if the pathogens are employed in a viable state and in sufficient quantity, they still may require several days of incubation before achieving desired effects which makes them unsuitable for most tactical applications.

Biological agents must be delivered under some exacting conditions in order to achieve mass casualties. If dropped in a standard bomb, most of the pathogens would be killed by the initial blast and the remainder would not be dispersed effectively.[22] If agents are incorporated into an aerosol, they must be sprayed within a specific microscopic particle

size range.[23] Weaponized pathogens, those produced as dry agent in the one to five micron range, are very susceptible to winds and therefore must be dispensed at relatively low altitudes and fairly close to the intended target. Owing to their fragility, biological agents are most effectively dispersed by covert (clandestine special forces) means or by a suitable sprayer platform (helicopter or slow-moving airplane). Either method might be risky in the face of determined and sophisticated U.S. defenses.

The American Way of War. As evidenced by the examples above, CB weapons are most effective against untrained, unprotected, massed troop formations. The U.S. General Accounting Office (GAO) is critical that U.S. military units are not realistically integrating CB defenses into exercises and training but states that units have all of their required CBW individual protective equipment and most of their required medical supplies, detection, and decontamination equipment.[24] It is easy to find other publications critical of the U.S. CBW program, but it is difficult to find references to CBW programs *better* than that of the United Sates. American forces may not have "perfect" CBW security, but faultless protection is not possible in the combat environment regardless of whether the threat is rifles, tanks, aircraft, or CB weapons. In addition to individual protection suits, some American fighting vehicles and vessels have built-in CB overpressure systems to allow "shirtsleeve" operation in a contaminated environment. Ground units incorporate integrated CB reconnaissance elements to detect CB agents in combat conditions.[25] Decontamination shelters are deployed with forces threatened by CB attack. So, on a relative scale, it is safe to say that the U.S. military personnel have effective and credible CBW training and gear.

Perhaps most vexing to a CB adversary is the American brand of warfare based on rapid maneuver supported by good air defenses, intelligence, and operational deception. As previously described, a potential CB target is most vulnerable when it is stationary. Airfields, ports, staging area, supply depots, troop concentrations, and command and control (C2) centers are most susceptible. Mobile units (ground, sea, or air) are very difficult to disable with CB agents. A moving ship or aircraft in flight could conceivably pass through a contaminated area, but the amount of exposure is likely to be small and evaporation would soon render the agent harmless. Mobile ground troops can avoid known areas of contamination and also provide only fleeting opportunities for would-be attackers. Without firm intelligence and time to plan and execute a strike, a foe would have difficulty employing CB weapons with sufficient precision and quantity against U.S. military forces.

Gulf War 1991: What If CB Weapons Had Been Used Then?

> This was exactly the war we had been equipping ourselves for, and frankly, we were damned good. Really, there's no question about that. And that's why even the threat of a chemical environment was not overly terrifying, because we had been training for years and years to fight in a chemical environment.
>
> H. Norman Schwarzkopf, *Desert Shield/Desert Storm: The 10th Anniversary of the Gulf War*, 2001

> Biological weapons are a wild card. We didn't know what the Iraqis had or what they might use, and the greatest threat from biological weapons would have been what they would have done to the civilian populations either in Saudi Arabia or in Israel or somewhere else as opposed to what they would have done on the battlefield . . . I was less worried about biological weapons [than chemical weapons].
>
> Colin Powell, *Desert Shield/Desert Storm: The 10th Anniversary of the Gulf War*, 2001

In the aftermath of the Gulf War, there has been much conjecture about what would have happened if Saddam Hussein had used CB weapons against the Coalition? His troops

where well-trained in CW and had protective suits and masks. Iraqi forces learned that using CW weapons in the rear areas (perhaps the Coalition's greatest vulnerability) could cut off front-line forces from re-supply and render them useless. Saddam's emissaries publicly stated Iraq would use CB weapons and Scud missiles could have been armed with CB warheads. Ten years after the war, the statements of General Schwarzkopf and Secretary Powell indicate they felt confident about military operations in the CB environment. Nonetheless, it is clear from their earlier recollections that they were both very concerned about the CBW unknown. The threat was real and there were stages during the Desert Shield buildup that Iraq could have caused numerous casualties and severely hampered the mission.

Iraqi CB artillery could penetrate only up to 32 kilometers (19.9 miles) so it did not pose a serious hazard to the Desert Shield build-up unless Iraq was willing to invade Saudi Arabia proper as during the ill-fated attack on Khafji.[26] Scuds equipped with CB warheads were assessed as too inaccurate for adequate concentration of chemical agents and were poorly suited to deliver biological agents intact. Prior to the war, General Schwarzkopf was assured by his intelligence community that the Scud chemical threat was minimal because the Iraqis had not solved problems with the missile's fuzing system. If Iraq launched a CB Scud salvo against a suitable area target such as an airfield or port, it might have caused temporary disruption in operations. Even so, environmental conditions would probably have minimized the impact.

Iraq's best CBW attack capability was aircraft. A U.S. Joint Staff Intelligence Summary[27] dated 13 January 1991 informed Desert Shield forces that if Iraq launched chemical attacks, bomb-laden Su-22s and MiG-23s would be the primary delivery vehicles

supplemented by helicopter-delivered rockets and aerosol sprays. Enemy aircraft could have flown 300 nautical miles from their forward bases in southern Iraq. Coalition forces were most susceptible to CB attack during the relatively short period before air superiority was achieved. Within ten days of the Iraqi invasion of Kuwait, the U.S. Air Force had deployed six fighter squadrons and one AWACS element into Saudi Arabia augmented by British and U.S. Navy carrier aircraft.[28] The Iraqi Air Force's poor showing and later retreat to Iran showed what an impotent force it was in the face of Coalition air defenses.[29] Once the aerial shield had been erected, there was little chance for Iraq to effectively use CB weapons anywhere except along the northern Saudi Arabian border.

The lesson is that Iraq's most effective CB weapons system could have achieved the most damage in the time of rushed mobilization prior to Coalition buildup of sufficient air defense systems. Many of the early arriving units showed up without adequate CBW defenses (personal protection suits, masks, detection devices, and decontamination equipment).[30] Albert Mauroni reports that by October 1990, there was enough chemical defense equipment and personnel in theater to erode Saddam's potential advantages.[31] Even then, the most lucrative CBW targets (ports, troop concentrations, and logistic centers) did not start receiving significant men and material until after Coalition air defenses were firmly in place. Air bases themselves could have been attacked, but as discussed in the previous section, even persistent chemical agents would have been a hazard for no more than 24 hours. If Iraq had launched biological attacks, its arsenal was relatively modest (25 Scud warheads and 157 gravity bombs loaded with biological agents)[32] which might indicate that BW was to be used more as a psychological weapon than a true battle

winner. Civilians in and around CB target areas would surely have suffered casualties, but protected military personnel would have been able to maintain operations.

Gulf War 2003: What If CB Weapons Are Used Tomorrow?

From a CBW standpoint, Iraq today is in a similar position to what it was in 1991. Iraq likely has significant quantities of secreted CB agents stored for the upcoming war with Coalition forces led by the United States.[33] Saddam Hussein is still at risk from internal overthrow and will probably retain a high degree of personal control over his CB stockpiles. Although Iraq's CB weapons denials have little credibility, Saddam may be reluctant to use them in combat as a way to garner sympathy and bolster his claims that Iraq is "clean." While he remains a duplicitous figure, it is clear from the current Iraqi media campaign that Saddam is concerned about world opinion. Iraq still can not compete militarily with the U.S. and will likely seek asymmetric advantage or at least try to inflict high casualties in an effort to make the war too costly.

Unlike the 1991 Gulf War, the U.S. military is in a far better position to counter the CB threat. Forces are already in place protected by U.S. air defenses which eliminates much of the buildup vulnerability experienced twelve years ago. There is no frantic rush to get "boots on the ground" without proper CB defensive equipment and the Patriot Advanced Capability 3 (PAC-3) missile promises to rectify some of the shortcomings of earlier Patriot variants against Scud attacks. Military units are widely dispersed throughout the region and are already well-trained and acclimated for desert combat. Fewer aircraft are able to destroy more targets in less time with all-weather near-precision (3-13 meter CEP) global positioning system (GPS)-guided weapons like JDAM and the GBU-37.[34]

Based on lessons from Gulf War I, Iraq has learned not to go "force-on-force" with the Coalition. Saddam Hussein will probably not mass his troops on the Kuwaiti and Saudi Arabian borders. Instead, he will pull them back to a defensive perimeter around Baghdad. This could leave a CB "free-fire" zone between Iraqi and Coalition forces which Saddam may exploit with aircraft and artillery. Conceivably, he could also impede advancing troops with pre-positioned CB "minefields" to contaminate large areas or the few available "choke points" (traffic constrictions caused by terrain, road junctions, population centers, or enemy activity). Lastly, he may launch CB Scuds at Israel, Coalition states, or even Iraqi Kurdish populations in an attempt to divert resources from the military and make regime change more difficult.

The U.S. too has learned from the previous war. Highly centralized command and control still remains ones of Saddam's weaknesses and it will receive considerable attention in Gulf War II. Because Scuds were so difficult to destroy with aircraft alone, special forces will reconnoiter and disable launchers as part of the opening air campaign. The air campaign itself will be shorter and more focused on crippling the CBW infrastructure. Once again, the U.S. military is well prepared to fight in the CBW environment. Operations may be degraded, but Iraq has little chance of stopping U.S. forces with CBW.

Conclusion

> Knowledge is power in gas defense. It saves casualties, increases the confidence of men in their own ability to protect themselves, and reduces fear.
>
> Brigadier General Alden Waitt, *Gas Warfare*, 1943

The purpose of this paper is not to minimize the CB threat, but rather to quantify the severity of the problem. Just because CB weapons are difficult to meld with military strategy and pose some practical delivery problems does not mean they will not be used.

On the contrary, this paper assumes they will be employed and asks what the impact will be on military operations? The conclusion of this research is that CB weapons are a serious hazard, but no more so than bullets or bombs. Much of our concern about CBW is churned by hyperbole and not supported by the facts. A soldier, sailor, or airman is still far more likely to be injured or killed by conventional arms than from gas or pathogens. CB weapons have the *potential* to wreck havoc, but the *reality* is that their effects are limited. United States military operations will probably be hindered by CBW, but not to the detriment of the overall mission. Armed with knowledge, commanders and subordinates can recognize that the CB threat in just as manageable as any other encountered on the battlefield.

NOTES

[1] Edward M. Spiers, Chemical and Biological Weapons: A Study of Proliferation (New York, NY: St Martin's Press, 1994), 113.

[2] Sun Tzu, translated by Samuel B. Griffith, The Art of War (New York, NY: Oxford University Press, 1971), 111.

[3] Albert J. Mauroni, America's Struggle with Chemical-Biological Warfare (Westport, CT: Greenwood Publishing Group, Inc, 2000), 5.

[4] Ibid., 257.

[5] Amy E. Smithson, Ataxia: The Chemical and Biological Terrorism Threat and the US Response (Washington, DC: The Henry L. Stimson Center, 2000), 279. Ms. Smithson initiated and directs the Chemical and Biological Weapons Nonproliferation Project, is a widely published author, and has testified before Congress on CB weapons nonproliferation issues. Before joining the Stimson Center, she worked at the Center for Naval Analyses.

[6] Brad Roberts, quoted by Spiers, 30 and 182. Mr. Roberts is the Chairman for the Research and Advisory Council of the Chemical and Biological Arms Control Institute, a member of the research staff at the Institute for Defense Analyses, and has testified before Congress on chemical warfare issues.

[7] A.T. Mahan, quoted by Charles E. Heller, Chemical Warfare in World War I: The American Experience, 1917-1918, (Fort Leavenworth, KS: U.S. Army Command and General Staff College, Combat Studies Institute, 1984), 3.

[8] Heller, 3. Spartan forces besieging an Athenian city placed a lighted mixture of wood, pitch, and sulfur under the walls. The Spartans hoped the fumes would incapacitate the Athenians so that they would not be able to resist the following assault. Peter R. Lavoy, Scott D. Sagan and James J. Writz, Planning the Unthinkable: How New Powers will Use Nuclear, Biological, and Chemical Weapons, (Ithaca, NY: Cornell University Press, 2000), 5. Fourteenth century Tartar armies catapulted plague-infected corpses into besieged cities, eighteenth century British troops distributed smallpox-infected blankets to North American Indians, and the Japanese released millions of plague-infected fleas into Chinese cities during World War II.

[9] Heller, 13-34.

[10] Ibid., 102.

[11] John Norris and Will Fowler, NBC: Nuclear, Biological and Chemical Warfare on the Modern Battlefield (Herndon, VA: Brassey's Inc., 1997), x.

[12] Ibid., 6.

[13] Ernest R. Dupuy and Trevor N. Dupuy, The Harper Encyclopedia of Military History, 4th ed. (New York, NY: Harper Collins Publishers, 1993), 1083. Dupuy and Dupuy put the grand total of WWI military battle deaths at 8.02 million, civilian dead at 6.64 million, and military wounded at 21.23 million.

[14] Farhang Rajaee, ed., The Iran-Iraq War: The Politics of Aggression (Gainesville, FL: University of Florida Press, 1993), 34-35.

[15] Mauroni, 212.

[16] Government Printing Office, The Biological & Chemical Warfare Threat (Washington, DC: U.S. Government Printing Office, 1999), 26-27; Mauroni, 256.

[17] Smithson, 280.

[18] John Eldridge, ed., Jane's NBC Defense Systems: 1998-99 (Alexandria, VA: Jane's Information Group, Inc., 1998), 19.

[19] Duncan Lenox, ed., Jane's Strategic Weapon Systems (Alexandria, VA: Jane's Information Group, Inc., 2002), 94.

[20] Glenn F. Burgess, "Counterchemical Warfare ConOps Now . . . Survive and Operate," Marine Corps Gazette, 86 (December 2002): 47-51. Col. Burgess is a senior analyst with Science Applications International Corporation.

[21] Raymond A. Zilinskas, Biological Warfare: Modern Offense and Defense (Boulder, CO: Lynne Rienner Publishers, Inc., 2000), 1. Mr. Zilinskas is a senior scientist in residence at the Monterey Institute for International Studies and a former UN weapons inspector.

[22] Smithson, 51; Sidney D. Drell, Abraham D. Sofaer, and George D. Wilson, eds., The New Terror: Facing the Threat of Biological and Chemical Weapons, (Stanford, CA: Hoover Institution Press, 1999), 86. According to Drell, Sofaer, and Wilson, "Explosive release tends to be inefficient (according to one estimate approximately 0.1 to 1 percent ends up in the 1 to 5 micron range) because explosions create fine aerosols very inefficiently and because heat and shock can kill a lot of agent.

[23] Ibid., 55.

[24] General Accounting Office, Chemical and Biological Defense: Units Better Equipped, but Training and Readiness Reporting Problems Remain, (Washington, DC: United States General Accounting Office, 2000), 5.

[25] Department of the Army, Headquarters, Field Manual No. 3-101: Chemical Staffs and Units, (Washington, DC: Department of the Army, 1993), 7-1.

[26] Bruce W. Watson, Bruce George, Peter Tsouras, and B.L. Cyr, Military Lessons of the Gulf War, (Novato, CA: Presidio Press, 1991), 93-94. Prior to the Coalition ground offensive, Iraq launched a border attack against the Saudi town of Khafji. Saddam Hussein's intent was to inflict casualties and force premature Coalition ground action. Coalition forces repulsed the attack and Iraq suffered significant losses: over 500 men lost (killed, wounded, taken prisoner) and over 100 vehicles destroyed. After the battle, General Schwarzkopf remarked that he "really began to think we were going to kick this guy's tail."

[27] Defense Intelligence Agency, Middle East--Africa Intelligence Summary 37-91, (Washington, DC: Defense Intelligence Agency, 13 January 1991), 1-6.

[28] Watson, George, Tsouras, and Cyr, 62.

[29] Ibid., 70. Iraq lost 35 aircraft in air-to-air combat while the Coalition lost none. 227 Iraqi aircraft were estimated destroyed on the ground and a further 115 combat aircraft were flown to Iran and other nations.

[30] Mauroni, 217-218. The 82nd Airborne Division was the first to deploy in August 1990. The unit discovered that their CBW masks had been poorly maintained and they were critically short of replacements. They had insufficient quantities of protective suits for extended large force operations which required stripping stocks in Europe and Korea. Until the first chemical defense units arrived at the end of September, the ground forces had only minimal indigenous detection and decontamination capabilities.

[31] Ibid., 218. Mr. Mauroni is a former U.S. Army chemical officer and currently works as a chemical-biological defense program management consultant for the Department of Defense.

[32] Drell, Sofaer, and Wilson, 109.

[33] United Nations, Security Council, United Nations Security Council Resolution 1441, Security Council meeting 4644, 8 November 2002, (New York, NY: 2002). It is quite clear from the verbiage in UNSCR 1441 that the voting member nations believe Iraq has undeclared chemical and biological weapons. Selected resolution paragraphs follow: "*Recognizing* the threat Iraq's non-compliance with Council resolutions and proliferation of weapons of mass destruction and long-range missiles poses to international peace and security . . . *Deploring* the fact that Iraq has not provided an accurate, full, final, and complete disclosure, as required by resolution 687 (1991), of all aspects of its programmes to develop weapons of mass destruction . . ."

[34] Federation of American Scientists, "US Smart Weapons," DOD 101 -- An Introduction to the Military, <http://www.fas.org/man/index.html> [17 January 2003]. The JDAM (Joint Direct Attack Munition) mates a GPS-guidance unit to conventional bomb bodies providing much better accuracies than standard "dumb bombs." The GBU-37 is a 5,000-pound class GPS-guided "bunker buster" employed by the B-2. While GPS-guided

weapons are not as accurate, hence the term “near-precision,” as laser-guided bombs or other ordnance fitted with visual sensors (optical or infrared), they can be employed by more aircraft types in any weather and are “fire-and-forget” weapons.

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